

*What is claimed is:*

1. A communication device for coupling to a communication medium and communicating at least two channels of data modulated with DMT line code using a common set of tones for both a transmit path and a receive path, and the communication device comprising:
  - an analog stage for converting on the transmit path digitized DMT symbols in the time domain to analog signals and said analog stage further for converting on the receive path analog signals into the digitized DMT symbols in the time domain; and
  - a digital stage for generating a selected one of time domain redundancy and frequency domain redundancy within the DMT line code for both the transmit path and the receive path to obtain symmetrical bandwidth on the transmit path and the receive path.
2. The communication device of Claim 1, wherein the digital stage includes a receive path further comprising:
  - a DFT logic for converting the digitized DMT symbols from the time domain to a frequency domain;
  - a multiple access decoder to combine a number  $RN$  of the digitized DMT symbols, where  $R$  corresponds with an order of redundancy in one of the frequency domain and the time domain and recover  $N$  DMT symbols; and
  - a tone decoder unit to convert the  $N$  DMT symbols to digital information corresponding with a selected one of the at least two channels.
3. The communication device of Claim 2, wherein said multiple access decoder further comprises:
  - a Walsh decoder for decoding the  $RN$  digitized DMT symbols using a unique Walsh code associated with the selected one of the at least two channels received.
4. The communication device of Claim 1, wherein the digital stage includes a transmit path further comprising:
  - a tone encoder unit to convert bits of information from a selected one of the at least two channels to  $N$  DMT symbols;

a multiple-access encoder to accept the N DMT symbols, and to generate a number RN of the DMT symbols, where R corresponds with an order of redundancy in one of the frequency domain and the time domain;

a DFT logic for converting the RN digitized DMT symbols from the multiple-access encoder from the frequency domain to the time domain.

5. The communication device of Claim 4, wherein said multiple access encoder further comprises:

a Walsh encoder for encoding the N DMT symbols with a unique Walsh code associated with the selected one of the at least two channels transmitted.

6. The communication device of Claim 1, wherein the digital stage includes a transmit path further comprising:

a tone encoder unit to convert bits of information from a selected one of the at least two channels to N DMT symbols;

a DFT logic for converting the N digitized DMT symbols from the multiple-access encoder from the frequency domain to the time domain; and

a multiple-access encoder to accept the N DMT symbols, and to generate a number RN of the DMT symbols, where R corresponds with an order of redundancy in the time domain.

7. The communication device of Claim 1, wherein the digital stage includes a transmit path further comprising:

a tone encoder unit to convert bits of information from a selected one of the at least two channels to RN DMT symbols, and to generate a number RN of the DMT symbols, where R corresponds with an order of redundancy in the frequency domain; and

a DFT logic for converting the RN digitized DMT symbols from said tone encoder from the frequency domain to the time domain.

8. The communication device of Claim 1, wherein the communication device comprises at least one of a physical modem and a logical modem.

9. The communication device of Claim 1, wherein the digital stage comprises a digital signal processor.

10. A method for communicating at least two channels of data between at least two modems each with a transmit path and a receive path and each of the at least two modems implementing DMT modulation and demodulation on the transmit path and the receive path respectively, and the method for communicating comprising the acts of:

implementing a common set of sub carriers for communications of the at least two channels of data between the modems and each sub carrier within the common set of sub carriers correlating with a respective tone within a common set of DMT tones;

generating one of time domain redundancy and frequency domain redundancy among the DMT tones transmitted and received by each of said modems to obtain symmetrical bandwidth for communications between said at least two modems across the common set of sub carriers.

11. The method of Claim 10, wherein the generating act further comprises the acts of:  
accepting a block of data for transmission;  
allocating each of N portions of a block of data for transmission to a corresponding subset of R tones of the common set of RN DMT tones to obtain frequency domain redundancy among the DMT tones transmitted and received by each of the at least two modems.

12. The method of Claim 11, wherein the allocating act further comprises the act of:  
assigning to each of the at least two modems a corresponding unique codeword for the transmission of data;  
encoding with the corresponding unique codeword each of the N portions of the block of data within the corresponding subset of R tones to create mutual orthogonality of the data transmissions between each of the at least two modems.

13. The method of Claim 10, wherein the generating act further comprises the acts of:  
accepting a block of data for transmission;

allocating each of N portions of a block of data for transmission to R common sets of N DMT tones to obtain time domain redundancy among the DMT tones transmitted and received by each of the at least two modems.

- 5    14.    The method of Claim 13, wherein the allocating act further comprises the act of:  
              assigning to each of the at least two modems a corresponding unique  
              codeword for the transmission of data;  
              encoding with the corresponding unique codeword each of the N portions of  
              the block of data within the corresponding R common sets of N DMT tones to  
10        create mutual orthogonality within the data transmissions between each of the at  
              least two modems.